

high voltage. We may estimate the voltage of this flash as of the order of 15,000,000 volts. The current intensity may have been 1,000 amperes; but these are only rough approximations. The cambium circle C (fig. 5) is 9 feet above the ground and the circumference of the tree at this point 150 centimeters. The circumference at the ground 250 centimeters. From C, the path is a shallow groove, with a deep V-shaped groove in the center, running down the tree to a point D (see figs. 5 and 6) where an explosive effect is seen, the water content of the cambium being evidently converted into steam at high pressure by the intense heat with the result that the bark was blown out and away. On both sides of the bare area, the bark is loosened to such an extent that a finger can be inserted between the bark and the cambium.

In Figure 6 a deeply cut inner groove can be seen, almost straight. This can be traced down to the ground (humus). In Figure 7, E, F, and G, the path can be distinctly seen as it plunges into the ground. Running directly west, the lightning made a clean cut furrow turning up the sod for a distance of 130 centimeters. In general the depth is 1 centimeter and width in places 13 centimeters. Reaching the limit of the sod, where a

gutter of the road begins—that is, a mixture of broken stone and asphaltum—the furrow disappears, and we assume that the energy of the discharge was at last completely dissipated by this grounding.

The disruptive effects seem to be more marked at the bottom of the tree than at the top. Indeed small branches and even twigs near the top and for some distance down, although quite near the path, that is, within 5 centimeters, were not injured in the least. This seems remarkable and we must assume a strong directive force in a vertical plane, and no splitting or side flashing. With most lightning discharges the disposition to split into branch discharges is marked. In near lightning this is also the case and in the 5,000,000-volt flash (near lightning) now used by F. W. Peek, jr., of the General Electric Co. in experimental work, as well as in the 3,000,000-flash shown in the MONTHLY WEATHER REVIEW, June, 1928, page 218, side flashes both up and down are to be seen clearly.

This flash then was unusual in that there is no twisting of the path, in that near-by and seemingly more exposed poles, trees, and buildings were not struck, and that there is no apparent explanation for the change in direction at the ground surface, nor for its abrupt ending.

WEATHER ABNORMALITIES IN UNITED STATES¹

551.583 (73)

ALFRED J. HENRY

(SECOND NOTE)

Continuing previous studies on this subject I have selected for study the weather of 1921. This year was characterized in the United States by unusual warmth, particularly in the cold months of the year as well as in the summer months; an island of cool weather of which eastern New Mexico may be considered as the center developed in June, persisted in July although the center was somewhat west of its June position and in August was found far to the northwest and much enlarged in area. The explanation of this restricted cool area in an otherwise warm month and its persistence through three months is not at hand.

In other countries abnormal weather prevailed; from the British Yearbook of 1921 I excerpt the following:

In all parts of the British Isles the abnormally mild weather which set in just before Christmas continued nearly through the whole of January. A feature of the month was the persistence of mild damp winds from the southwest or west, with much low cloud. The movement of depressions was generally eastward across the British Isles, 16 primary and 2 secondaries have been charted.

February: The pressure distribution over west and northwest Europe during the month was largely dominated by a series of important anticyclones. Depressions followed paths well to the northward or southward of the British Isles. A very dry month in England and Wales.

March: The conditions over northwest Europe during March were of a westerly to southwesterly type, with frequent depressions in the neighborhood of the arctic circle and relatively high pressure between the Azores and Europe. As in the two preceding months there was a marked absence of severe wintry weather over western Europe generally and even in Sweden there was little frost after the 9th. Brief incursions of polar air were accompanied by snow in the northern districts of the British Isles at times in the first week, and in western districts on the night of the 28th but milder weather followed in each case. Ten depressions were charted moving almost due east about latitude 65.

June was very dry, July fine and warm, August unsettled, September mostly fine and warm, October very warm, sunny and dry, November cold, dry, and foggy, and December unsettled, mild, and windy.

Considering the Northern Hemisphere as a whole and using the data published in *Reseau Mondial* for 1921 it would appear that for the most part the year must be classed as a warm one.

In that publication the records of 269 stations having normal temperatures are given with the deviation from normal for each station. Combining these in a table by months it is found as shown in the table below that only the months September to November were relatively cool. The table follows:

TABLE 1.—Per cent of stations in Northern Hemisphere having positive departures in 1921. Mean monthly solar constant values in second line (after Abbot)

	January	February	March	April	May	June	July	August	September	October	November	December
Per cent.....	68	54	61	54	58	53	58	50	43	49	39	58
Solar constant.....	1.955	1.956	1.949	1.944	1.943	1.939	1.956	1.944	1.969	1.962	1.951	1.953

From this showing it would seem that some extra-terrestrial influence must have been operative and one naturally turns to changes in the incoming solar radiation. I have, therefore, included in Table 1 the monthly mean solar constant values as published by Abbot.² Thus it may be seen the solar constant values for January, February, July, and December were greater than the normal of 1.94 calorie, and that no single month was below that figure, two place decimals only being considered. The months of greatest solar constant values, however—September and October—were not associated with pronounced terrestrial temperature departures.

The sun-spot numbers for 1921 were not large; the minimum of 1923 was approaching. While the increase in solar radiation does not closely tie up with increased terrestrial temperatures it can not be dismissed from consideration. It might be argued that the effect of an increase or decrease in solar radiation should be felt more

¹ cf. Henry A. J. Weather abnormalities in United States this REVIEW. Vol. 56.

² Abbot, C. G. Smithsonian Misc. Coll. Vol. 80, No. 2, p. 6.

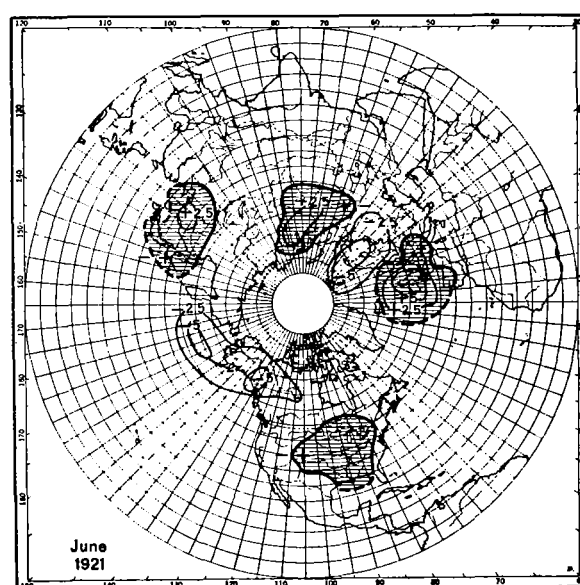
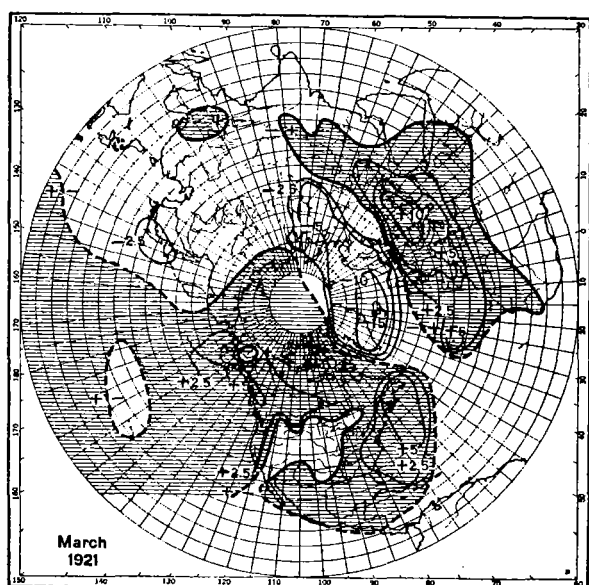
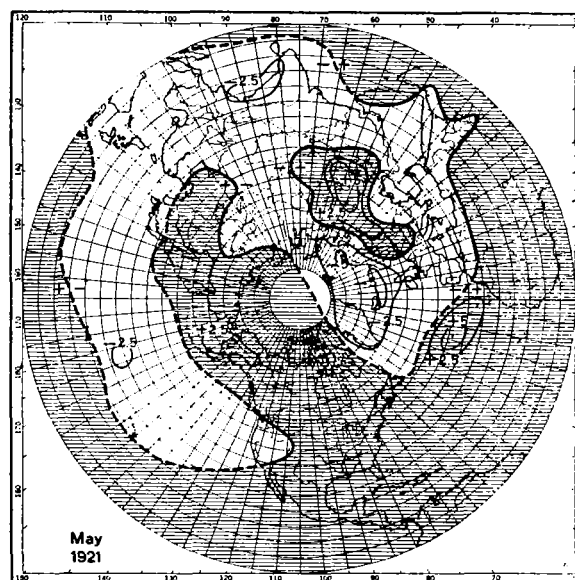
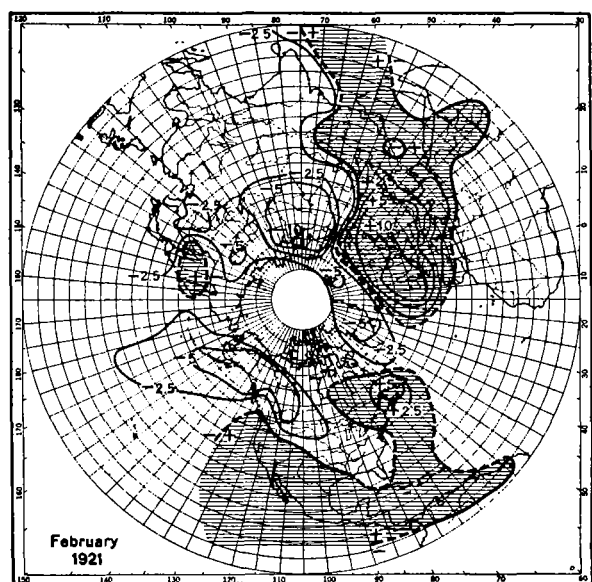
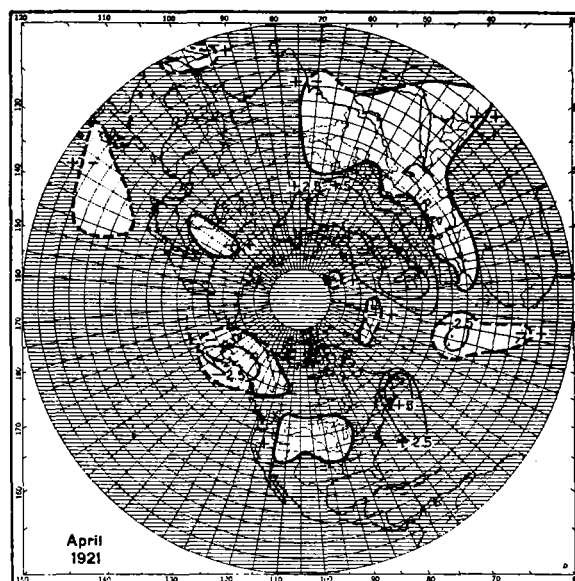
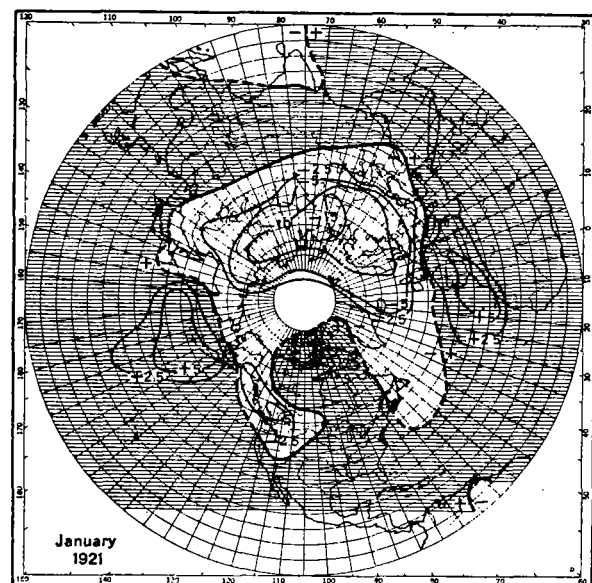


FIGURE 1.—Pressure-anomaly charts for Northern Hemisphere, January-June, 1921

or less uniformly in all latitudes. On the other hand temperature in mid-latitudes varies to a greater extent than in the Tropics and the larger increase in the temperate latitudes as was the case in 1921, may be the expression of a climatological law rather than a measure of the effect of solar radiation.

Since atmospheric pressure is the dominating control of the winds and thus of temperature I have prepared pressure abnormality charts for the first six months of 1921, from the data of *Reseau Mondial* for that year. These charts are shown in Figure 1.

The charts speak for themselves. I may, however, point out one or more of the outstanding features.

January, 1921.—The very extensive area of negative anomaly that is centered mostly along the sixtieth parallel of the Eurasian continent and, indeed, may extend across the north polar regions to Alaska, evidently dominates the temperature distribution of the Northern Hemisphere. No part of the north polar area except northern Greenland shows a positive anomaly and that of North Greenland is of little intensity. High pressure in the eastern Atlantic is conducive to warm weather as far south as the Mediterranean in Europe, provided, of course, the pressure is continuously high so as to prevent the incursion of cold air from high latitudes.

February, 1921.—The essential change in pressure distribution from January to February is the upbuilding of areas of positive pressure variations, not in high latitudes, but along the fiftieth parallel of north latitude in North America and from 50° to 60° north in Europe. The apparent effect of this change was largely local in that negative temperature variations were recorded in the areas of positive pressure change. The negative pressure anomaly of February is more wide spread than that of the previous month, although the amplitude of the variation is somewhat less.

March, 1921.—The change from February to March is small and relatively unimportant the regions of positive and negative variations being almost identical in both months.

From March to April the change is also small and unimportant, the amplitude of the variations being somewhat reduced, as is to be expected with the passage from winter to summer conditions.

The weather in the United States and Canada for any month is the direct result of the frequency, character and paths followed by cyclones and anticyclones that may enter the continent from the North Pacific or develop over continental areas from primary formations that reach the eastern margin of that ocean.

The foregoing named considerations impel us to look to the west and northwest rather than to the east and especially to so distant a region as Europe for the explanation of weather abnormalities in the Northern Hemisphere.

The January, 1921, pressure anomaly chart hereinbefore described clearly indicates as an outstanding feature low pressure in north polar regions. In North America, however, it appears that the low pressure in western Canada and interior Alaska is closely circumscribed by higher pressure in Bering Sea and the Aleutians immediately to the west and northwest of Alaska. The positive deviation of pressure from normal for January was 5.5 and 7.6 millibars at St. Paul and Dutch Harbor, respectively. This fact may be interpreted to mean that the usual midwinter storminess at those points was somewhat abated at times of well above normal pressure. The mean January sea-level pressure at Dutch Harbor

is 29.63 inches, while the mean January, 1921, sea-level pressure was 29.86 inches. An inference which immediately follows is that cyclonic storms should enter the continent at lower latitudes than when pressure in the Aleutians is below normal. Chart III, *MONTHLY WEATHER REVIEW*, January, 1921, shows that with but three exceptions cyclones entered the continent either directly over the Washington coast or by the development of secondaries over Alberta. All of these and the three which developed over western United States moved almost due east/west. This fact coupled with the fact that six of the nine anticyclones of the month came from the Pacific and but three had their origin in Canada and those were of but little intensity clearly fixes the responsibility for the mild January weather experienced in North America during January, 1921.

In like manner the frequency and paths of cyclones and anticyclones during February, March, and April have been examined. The pressure anomaly in February was much the same as in the preceeding month with the exception that considering North America only, the region of negative anomaly has spread far to the southeast even to Florida and the path of cyclones to the northeast over the upper portion of the North Atlantic remained open notwithstanding the upbuilding of the large area of positive anomaly over middle and western Europe. The Alaska area of negative anomaly seems to have an arm stretching far to the southwest if the evidence of Midway and Honolulu suffices to establish that fact.

March shows some changes in the pressure abnormality for North America, the upbuilding of a rather small positive abnormality over coastal Alaska and extreme western Canada and also over the western part of the North Atlantic between the Canadian Maritime Provinces and Bermuda. The effect of the latter was to increase the temperature abnormality of eastern United States and the St. Lawrence Valley regions so that each showed positive temperature variations of as much as 12° F. above the normal. In this month the course of cyclones northeastward via the Greenland-Iceland route remained open.

In April the uniformly high temperature over United States and Canada came to an end, since practically the whole of the area west of the Rockies had a mean temperature of from 3° to 6° below the normal due, it is believed, to the development of a group of four secondary depressions over the southern Plateau and the absence of Alberta cyclones. The anticyclones of the month were rather few in number and of small intensity.

The weather of May, 1921, was due to two sharply contrasted conditions, viz, the presence during the first half of the month of high pressure along the northern border with cool northerly winds and, second, to a change in the pressure distribution whereby pressure over the western Atlantic increased and thus inaugurated a flow of southerly air over eastern United States and Canada. For the month as a whole temperature was rather close to the normal.

In June, 1921, temperature was considerably above the normal except in a small area of which eastern New Mexico represents the center. An explanation of this apparent anomalous condition is not at hand, but that it was not the result of local conditions seems assured since an almost similar area was in evidence in both July and August. In the last named it appeared far to the northwest of its position in June. The pressure-anomaly chart for June suggests that the large area of deficient pressure

over Russia and Alaska, respectively, may have been but a single area that stretched across the north polar regions.

The heat and drought experienced in the British Isles in 1921 has been studied in great detail by Brooks and Glasspole (*Quart. Jour. Roy. Met. Soc.* 48: 139-168). Sir Napier Shaw has also written on the subject in *Forecasting Weather*, pages 119, 173, 375, 556.

The world-wide bearing of pressure anomalies in Europe and Asia on the weather of the United States, or more properly speaking on the weather of temperate North America, as I see it, lies in the fact that great positive-pressure anomalies over the Greenland-Iceland region will block the free advance of cyclones passing northeastward over the United States and Canada, and on the other hand when pressure in the high latitudes of Europe is low the rapid advance of cyclones over North America is favored. The rapid movement is favorable to high temperature and little precipitation.

(THIRD NOTE)

The abnormality here considered is that of pressure in the Aleutian Low during the winter months of 1925-26 and the discussion is based on only such data as are contained in Weather Bureau records plus a few scattering reports that have been compiled by the author from published reports of foreign weather services. The *Meteorological Magazine* for February, 1926, has been very helpful in giving a view of the conditions which prevailed in the North Atlantic and the British Isles.

The outstanding features of the weather in various parts of the world were the total disappearance of the semi-permanent anticyclone of the northeast Pacific during the last 10 days of the month, the abnormally low pressure in the Aleutian semipermanent cyclone, the record-breaking high temperatures in Alaska and elsewhere in North America and finally the unusual storminess of the North Atlantic where during the latter part of the month the winds attained hurricane force over a very considerable area. Whether the storminess in the North Atlantic was in any way related to the low level of the pressure in the Aleutian Low and the disappearance of the northeast Pacific anticyclone is, of course, problematical. It seems reasonable, however, to think that the intensity of the North Atlantic storms was directly due to intensity of the Aleutian Low. The writer said in *MONTHLY WEATHER REVIEW* 54: 70 that cyclonic storms of January, 1926, passing over the Atlantic in the neighborhood of the Canadian Maritime Provinces had a tendency to greatly increase in intensity as in the previous month.

The center of the Aleutian Low remained at Dutch Harbor during the two succeeding months of February and March, 1926, though the mean level of the pressure rose somewhat, the sharp rise from the low level of January did not come until in April and May and it was not until June that pressure returned almost to its normal level at the Dutch Harbor station.

Some idea of the magnitude of the pressure departure in the Aleutians may be had from Figure 1 below. I am indebted for this and the next following figure to H. J. Thompson¹ who originally prepared both figures.

The mild temperatures experienced in Alaska and along the coast southward to British Columbia, were most remarkable, ranging from 30° above normal at Dawson,

to 11° at Prince Rupert, British Columbia. The temperature distribution is shown in Figure 2.

Temperature.—There are, of course, few long-period temperature records in Alaska, that of Sitka being the longest. The January, 1926, mean temperature at that place was 43.2° F.—a mean temperature corresponding to the January normal in the latitude of Atlanta, Ga., thence westward across northern Alabama, northern Mississippi and Texas and continuing thence to the point where it emerges upon the Pacific at latitude 42° north, on the boundary between California and Oregon. Hence it is seen that the temperature experienced at Sitka, Alaska, in January, 1926, was normal to the latitude of northern California, more than 1,000 statute miles to the southward.

It would seem as if the mark made by the mild winter of 1925-26 in Alaska would stand for a century or perhaps more.

The *MONTHLY WEATHER REVIEWS* of both Canada and the United States portray graphically the variation of the temperature from normal month by month. These publications show that for North America west of the one hundredth meridian and north of the thirty-fifth parallel of north latitude in December, 1925, the above described territory was unduly warm the variations above the normal ranging from 10° in Montana to 14° in parts of British Columbia and still farther north in the Mackenzie Basin. The cause of the increase in temperature in December, 1925, was the same, low pressure and its control of the winds, as brought about the peak of the warming in the next succeeding month.

In January, 1926, the peak of the relatively high temperature, as shown by the departures from the normal, was reached in the Yukon Valley at Dawson, 30° above the normal, diminishing thence to the border between the United States and Canada, where it amounted to but 4° on the coast rising to 12° along the border as far east as Winnipeg. A part of this warming must have been due to the foehn effect as the westerly winds descended to the lower elevations to the eastward of the mountain systems that parallel the coast.

Great variations in the temperature both positive and negative frequently appear on the departure chart published monthly in the *WEATHER REVIEW* for the United States in such form as to suggest a spreading fan-shape to the southeastward east of the Rocky Mountains of the lines of equal departures diminishing from a maximum along the northern border to a minimum in lower latitudes. One can easily visualize the equatorward flow of cold air from high latitudes but a flow in the reverse direction seems quite improbable.

If such a flow did take place, naturally the greatest positive abnormality would be found in lower latitudes, progressively diminishing with penetration into higher latitudes. Such a distribution has never been observed but rather the contrary, as exemplified by Chart III, January, 1926 *MONTHLY WEATHER REVIEW*, vol. 54.

In this case the cause of the high temperature can not be ascribed to southerly winds since the barometric situation demanded wind of northerly component. The fact that this unusual warming did not extend south of the thirty-fifth parallel of north latitude seems to confirm the belief that the down-slope drift of over-warmed air of high latitudes is effective in raising the temperature in lower latitudes.

In the succeeding month of February the high temperatures had overspread all of the United States, except the Florida Peninsula, New England, New York, and the greater part of Pennsylvania. This month marks the

¹ Cf. Thompson, H. J. Alaska's mild winter of 1925-26. *Mo. Wea. Rev.* 54: 256-60.

greatest southeastward thrust of the high temperatures of the far northwest. In March, while northwestern United States had temperature above the normal the greater part of the country had subnormal temperatures amounting to as much as 6° in the lower Ohio Valley and the northern parts of Alabama, Mississippi, and Georgia. In this month subnormal temperatures prevailed also in the Hudson Bay region, thence southwestward to Winnipeg and south practically to the Gulf of Mexico. In April immediately following while temperatures remained above normal in Alaska and thence south to the Mexican border, the eastward extension of the warm weather did not extend more than about 200 miles from the coast on the south but at least to Winnipeg on the north. (See Chart III, April, 1926, REVIEW.)

Variations in elements other than temperature—Pressure.—The swing of pressure in the Aleutian Low was one of long period, in the sense that it was greater than a week or 10 days. Pressure began to fall in November, 1925, and did not return to normal until June, 1926, thus making a complete oscillation in about eight months. There was noticed in November, 1925, an increase in the intensity of the general circulation as manifest in the storminess over the North Pacific Ocean. Eighteen cyclonic storms were plotted as passing over continental United States during the month, several of which were of considerable intensity.

In December, 1925, the continental extension of the northeast Pacific anticyclone was centered over the Great Basin with a monthly mean pressure of 30.32 inches at Boise, Idaho. Coincidentally with the presence of this anticyclone the oceanic anticyclone, which is usually found off the California coast, was greatly weakened and as a result cyclones moved east-northeast across the Pacific in paths somewhat south of the Dutch Harbor route. Evidently, since the number of cyclones and anticyclones that entered North America in December, 1925, was less than usual the shifting of the path of

cyclones to the south, as above recited has no important bearing on the storminess of the United States.

Passing now to a consideration of the pressure distribution of January, 1926—the month during which the peak of the fall was reached—I wish to call attention to an article by Thomas R. Reed of the San Francisco Weather Bureau Office.¹

Mr. Reed points out in his article that there was a change in the type of pressure distribution over the Pacific Ocean as shown in his two figures, reproduced as Figures 3 and 4 below. The essential feature of the change referred to is that pressure in the second period is lower than in the first and the anticyclone off the California coast shown in the first period has entirely disappeared in the second period. During the period January 1 to 24 pressure in the Great Basin anticyclone was high and cyclones were not able to enter the continent along the coast between British Columbia and Mexico. On or about the 24th pressure over the Great Basin began to fall as cyclones penetrated the continent north of the border between Canada and the United States; it was not, however, until January 31 that a cyclone was able to pass inland in the vicinity of San Francisco. Other cyclones followed and much needed rain fell in California and adjoining States. So far as surface observations are concerned there is no clue to the cause of the continued fall in pressure in the Aleutians which reached the low point of 28.4 inches on the average for the 10 days, January 24–February 3, 1926, and brought the level of pressure in the Great Basin anticyclone from its high value of 30.5 inches for the first half of the month to less than 30 inches in early February.

Pressure in the Great Basin anticyclone, as at Boise, Idaho, maintained a high level for the first half of January, not falling below 30 inches until the 17th; it then rose immediately well above 30 inches and did not again

¹ Reed, Thomas R. Average pressure for oceanic areas computed from daily synoptic charts, This Rev. 54: 1-2.

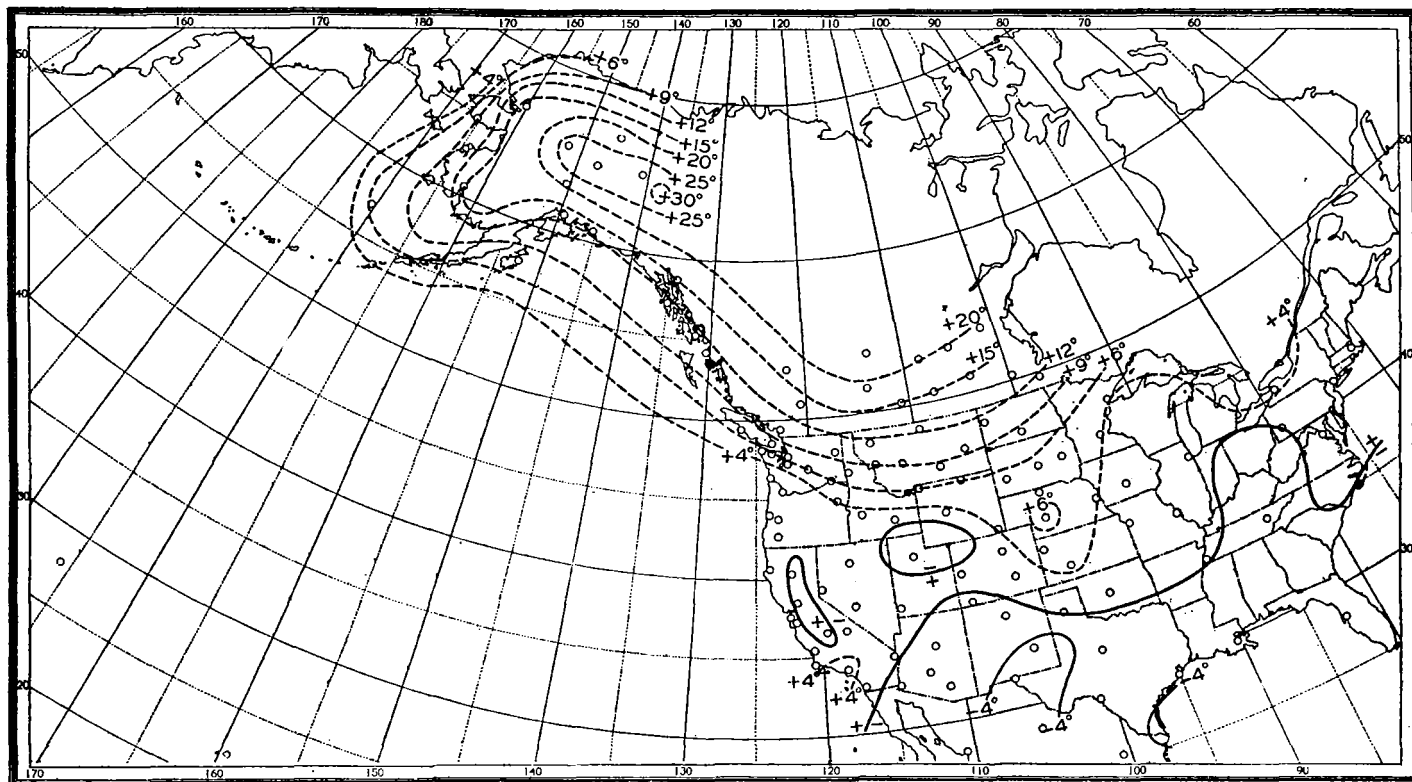


FIGURE 1.—Departures of temperature from the normal in Alaska, Canada, and part of the United States, January, 1926

descend to 30 inches until the 29th; it then rose to 30.09 inches and fell to 29.78 inches on the 31st of the month.

Alaska pressure in previous Januaries.—This discussion would be incomplete without reference to previous months of the same name having pronounced low pressure.

January, 1919, experienced the greatest dip of pressure below normal in Alaska previous to January, 1926, of which records are available. In that month the area of negative anomaly extended westward over the Aleutians and to the southeast across Canada and the United States to the Atlantic in the neighborhood of the Canadian Maritime Provinces, thence northeast to southern Greenland. The maximum negative abnormality in North America was 14.8 millibars at Tanana, Alaska. In Europe a rather large area of large negative anomaly stretched from the British Isles southeastward to the Mediterranean and indeed in less intense form to the Red Sea. On the opposite of the globe large areas of positive anomaly were present with the maximum abnormality of 16.5 millibars in high latitudes in Russia.

In the United States the weather was warm and dry, the warm weather, however, did not extend to the southern border of the United States, except in southern California and the lines of equal abnormality of temperature also show the southeastward spread as in January, 1926.

The pressure distribution in January, 1919, suggests the mass movement of cyclones across North America along the border between Canada and the United States, thence across the Atlantic in rather higher latitude than usual to northern Europe and thence a spreading more or less to the southeast. I have, however, no confirmatory evidence on the last point.

January, 1915.—This month, while similar in many respects to that of 1919, is different in others. The temperature in the United States in January, 1915, was quite unlike that of 1919, the distribution being a mixed

one—warm in some portions and cold in others, perhaps due to the distribution and movement of cyclones and anticyclones—there being a greater number of anticyclones descending from Canada and a rather pronounced movement of cyclones across the United States in low latitudes than in January, 1919. Pressure over the Atlantic was higher than in that year and this may have been a factor in the distribution of temperature and rainfall.

January, 1914.—This month was unique among those considered in the fact that pressure was below the normal apparently over the greater part of the Northern Hemisphere especially in the higher latitudes. The negative anomaly evidently extended across the north polar regions and was most intense (had the greatest amplitude) at the Russian station Oust Tsylna and east of the Urals at Eneiseisk, northwest Siberia, the depression of the barometer at the two places being 0.58 and 0.43 inch, respectively. In North America a depression of 0.36 inch was noted at Prince Rupert, British Columbia, and 0.31 inch at St. Johns, Newfoundland.

The course of the cyclones that entered the United States from the Pacific was almost due east along the northern circuit, there being but two storms—both secondaries—that passed northeastward from the Gulf region. Anticyclones were about as numerous as usual and displayed no striking features, except that those occurring during the second half of the month lacked in intensity, thus in a measure accounting for the exceptionally warm weather in every part of the country save New England and the extreme southern tip of Florida.

January, 1921.—This month has been discussed in the second note on weather abnormalities; in this paper we shall content ourselves with the statement that it was a very warm midwinter month and was followed by two months each having temperature much above the normal. Pressure in Alaska was below the normal but not excep-

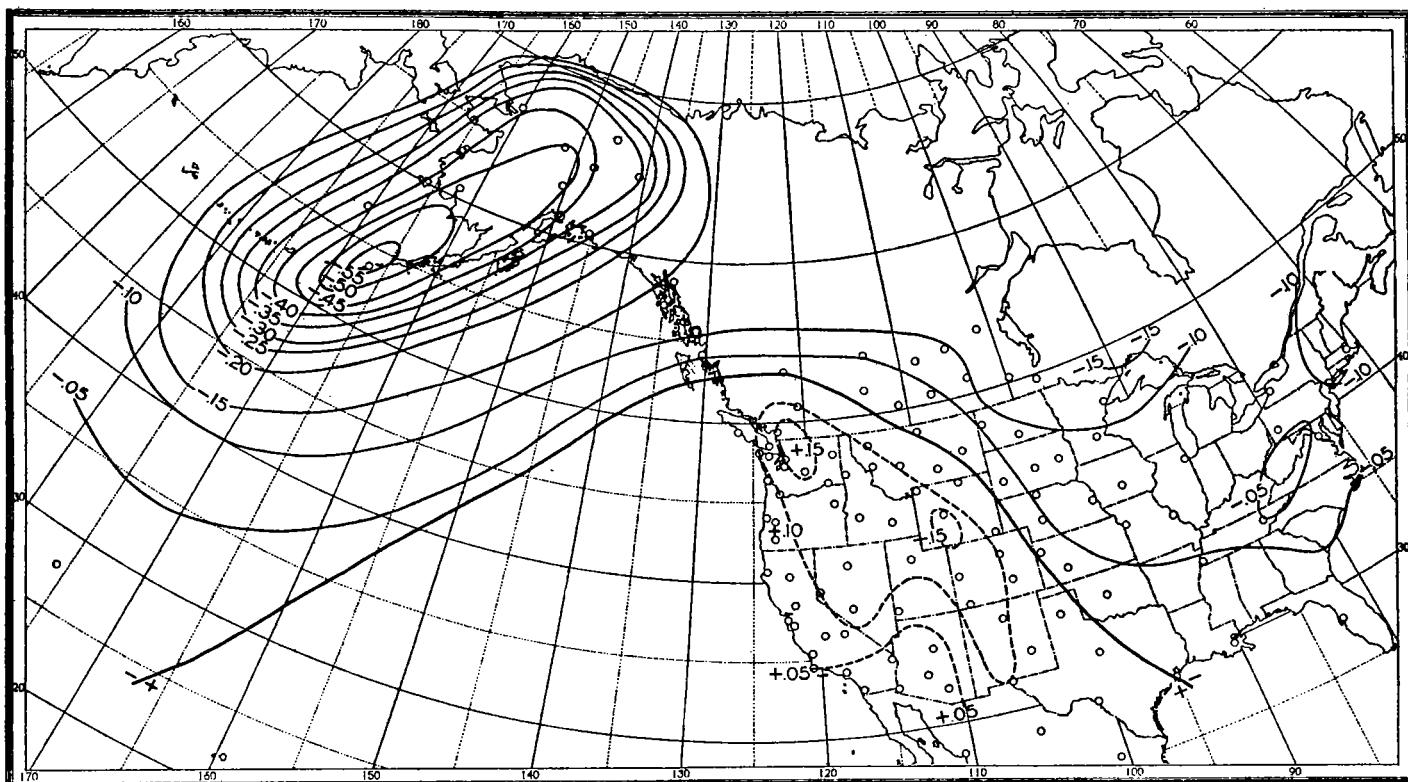


FIGURE 2.—Departures of sea-level pressure from the normal over the northeast Pacific and adjoining land areas for January, 1926

tionally so. This concludes the series of five Januaries with negative pressure anomalies in Alaska.

It seems reasonable to conclude therefrom that low pressure in Alaska and the Aleutians is concomitant with

mild and rather dry weather in the United States, except that generous rains are probable in the Southeastern States.

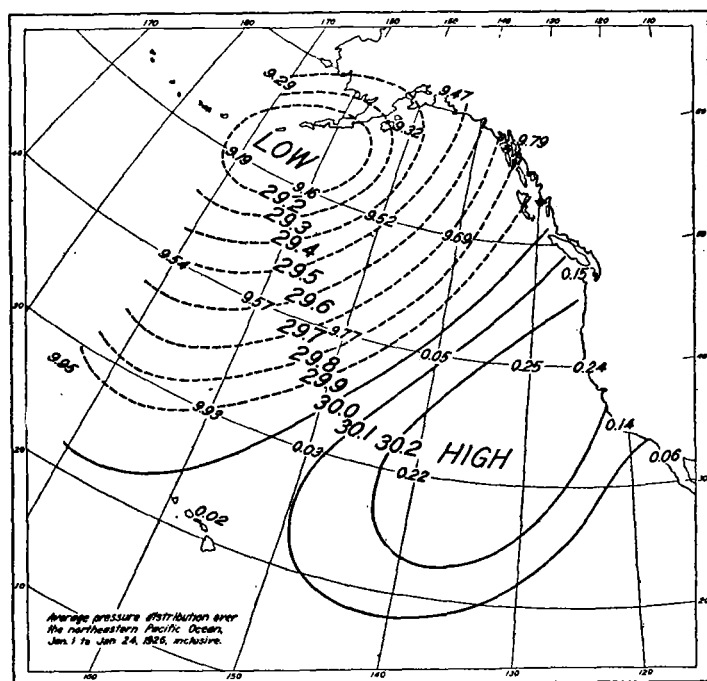


FIGURE 3.—Average pressure in inches over the northeastern Pacific January 1 to 24, 1926

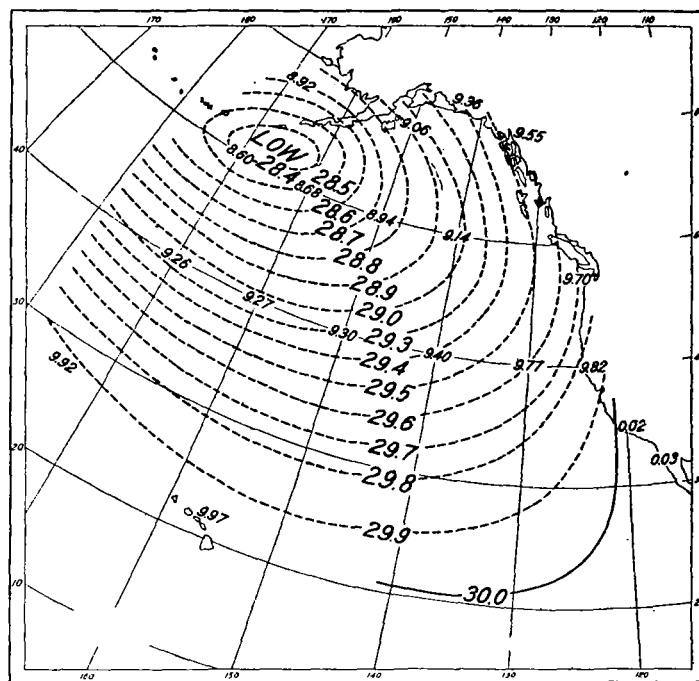


FIGURE 4.—Average pressure in inches over the northeastern Pacific January 25 to February 5, 1926

551.5: 523.4 (048)

NOTES, ABSTRACTS, AND REVIEWS

Some human aspects of astronomy (excerpts from a paper on "Modern Astronomy," by C. G. Abbot, in the *Annual Report of the Smithsonian Institution*, 1927, pp. 163-166. It has recently been observed that the illuminated side of Mars reaches equatorial temperatures approximating those of our spring days in Philadelphia. Both oxygen and water vapor have been demonstrated in the atmosphere of Mars, but in comparatively minute quantities. Adams and St. John find of oxygen 15 and of water vapor 5 per cent of the quantities prevailing in our atmosphere. So the Martian life, if it exists, must be adapted to atmospheric composition approximating that high above the summit of Mount Everest.

As the atmosphere of Mars is so very rare and dry, it is unsuitable to retain heat at night. Computation and observation unite in estimating the midnight temperatures of equatorial Mars as of the order of -40°C . These frigid night temperatures, combined with the rare and dry atmospheres, would seem to exclude from Mars the higher types of life, such as we know, but might permit certain arctic types to exist. Indeed, the seasonal changes of color which are observed, seem to many to be satisfactory evidence of vegetation on Mars.

Upon Venus there is no defect of temperature, or of the uniformity of it. With greater nearness to the sun but higher reflecting power, the solar radiation available to warm Venus is about one and four-tenths times as intense as that which warms the earth. Accordingly, temperatures approximating those of our Tropics should prevail in latitudes well toward this planet's poles. An abundant atmosphere is present. The reflecting power approximates that of a completely cloudy earth, so that

it would be reasonable to conceive of clouds of water, completely hiding the planet surface at all times.

The spectroscope, however, does not confirm this. Neither water vapor nor oxygen can certainly be discerned thereby. Yet it seems incredible that we see the surface of this planet, whose bulk must be solidified since its density is nearly the same as the earth's. For if solid, surely it would present some visible markings, and Venus never does. Accordingly, it is supposed that the clouds of Venus are of the high-level cirrus type, and that water vapor, though present plentifully below the clouds, is too scanty at higher levels to be revealed. As for oxygen, though certainly it can not extend as high as it does above the earth, it may be present beneath the cloud level.

No spectroscopic evidence of the rotation of Venus has ever been found. This proves that the planet does not rotate very rapidly, like the earth or Mars. It has even been suggested that, like the moon, its rotation and revolution periods are identical so that Venus would present the same face to the sun at all times. If that were so, the bright face would be very hot, and the dark face very cold. Recently, however, Pettit and Nicholson have found that the dark side of Venus is about equally warm from one edge to the other and is everywhere at about the same temperature that our earth would appear if viewed from another planet. This observation of moderate and equable night temperatures proves that the planetary rotation must be fairly rapid, and certainly not of the same period as the revolution. We may therefore conclude that Venus is very probably appropriately provided with temperature, humidity, and atmospheric conditions, and is in a state suited for luxuriant life.